INTERFACULTAIRE WERKGROEP TAAL- EN SPRAAKGEDRAG, UNIVERSITY OF NIJMEGEN

A PROGRESS REPORT OF RESEARCH ON LANGUAGE AND SPEECH BEHAVIOUR

THE FIRST TWO YEARS: OCTOBER 1976 - SEPTEMBER 1978

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1. INTRODUCTION

This brief and informal report is a response to the questions "What is the Interfacultaire Werkgroep?" and "What does it do?" We hope, then, to clarify (a little) some of the mystery that surrounds our rather diverse activities across a number of research areas in a large number of places. The reader should, however, be prepared for the fact that both the structure of our organization and the content of the group's work is expanding and shifting in emphasis during these initial years.

2. WHAT IS THE WERKGROEP?

The Interfacultaire Werkgroep Taal- en Spraakgedrag (IWTS) was officially established in December 1975 as a co-operative research venture of three faculties of Nijmegen University: the faculties of Medicine, Languages, and Social Science. Later, a fourth (inter-)faculty, Philosophy, was added.

The announced aim of the Unit was to stimulate, co-ordinate, and undertake fundamental interdisciplinary research in the general area of language and speech studies. The motivation for developing such an effort was essentially the following: Over the course of the years, several units in different faculties had become aware that they were dealing with problems concerning the use of natural language that crossed the customary methodological and theoretical bounds of the respective individual disciplines. Slowly but surely a web of informal research contacts developed between these units. Several examples of successful co-operation led to the recognition that a more systematic organization of these joint efforts might develop into a highly productive situation in which otherwise unsolvable problems might be brought within the reach of empirical study.

Following the official establishment of the Unit, some working groups were formed consisting of staff from different departments with the immediate aim of writing grant proposals for projects of common interest. These and later grant proposals have been submitted to the University Research Pool, The Netherlands Organization for the Advancement of Pure Research (ZWO), The Ministry of Health, and the Stichting Kinderpostzegels. During this period the University Board granted one permanent place to the Unit in order to appoint a full-time head. This position was filled by Dr. J.C. Marshall, who assumed his duties in October 1976. Since that time, several of the granted projects have been launched, others have been funded for further continuation,and a number of new projects have been successfully applied for. This has involved the appointment of various young researchers from many different disciplines.

Our current organization consists of a steering committee with the following members: Professor W.F.B. Brinkman (Keel-, Neus- en Oorheelkunde, KNO), Prof. J.J. Dumont (Pedagogisch Instituut, P.I.), Dr. F.J.M. Gabreels (Kinderneurologie, KN), Professor A. Kraak (Algemene Taalwetenschap, ATW), Professor W.J.M. Levelt, Chairman (Psychologische Funktieleer, PF, and Max-Planck Projectgroup, MPG), Dr. P.A.M. Seuren (Filosofisch Instituut), Dr. A.J.W.M. Thomassen (Psychologische Funktieleer), Dr. F.J.M. van Els (Instituut Toegepaste Taalkunde, ITT). and Professor W.H. Vieregge (Instituut voor Fonetiek, IFN). The head of the Workgroup, Dr. J.C. Marshall, ably assisted by the dedicated secretarial help of Mrs. Magda Thoeng, is responsible to the above board. Past and present research staff include: Drs. K. de Bot (ITT and IWTS), Drs. P. Eling (PF and IWTS), Drs. F. van Galen (IWTS), Drs. Ch. Hermans (IWTS), Drs. M. Loffeld (until August 1977), Ir. G. te Meerman (until August 1978), Drs. R. van Rijnsoever (ATW and IWTS), Ir. H.L. Teulings (PF and IWTS), Dr. L.K. Tyler (IWTS), and Ir. P. Wichern (until September 1978). In addition, a number of graduate students have collaborated on Werkgroep projects: These include Drs. A. de Groot (ATW), Drs. A.M.L. de Jong (PF), Drs. R. Verdiezen (ATW) and Drs. G. Poelwijk (ATW). Other colleagues from Nijmegen (and elsewhere) who have collaborated with members of the Werkgroep will be mentioned when our research is discussed. We must add here, however, a word about the working arrangements of the group.

The system of working groups has been found effective and therefore has been preserved and expanded. Each funded project is supervised

by a small, interdisciplinary working group, normally but not invariably chaired by a member of the steering committee and the head of the Unit. Apart from already funded projects, new research initiatives are constantly being developed through pilot research, and, in later stages, by the preparation of new grant proposals by new working groups. The initiative for these projects can come from anyone involved with the Unit, especially members of the Steering Committee and the Head of the Unit.

We should also mention that a very substantial project proposal was prepared during 1977. Together with the Max-Planck Projectgroup for Psycholinguistics (Nijmegen), and the Institute for Perception Research, IPO, (Eindhoven), the Unit submitted a "special project" on Descriptive Language to the Dutch Ministry of Education. The Steering Committee for the project consists of Prof. W.J.M. Levelt, Dr. J.C. Marshall, and Dr. H. Bouma from IPO. The Ministry has reserved funds to develop this project during the years 1978-1981. The mediating scientific organizations are ZWO and the Max-Planck-Gesellschaft. Four working groups, led by Dr. S. Nooteboom (IPO), Dr. G. Kempen (PF), Dr. P. Seuren (FI), and Dr. W. Deutsch (MPG) are currently in operation. Another joint activity with the Max-Planck group has been the establishment of a colloquium series, run by Dr. W. Marslen-Wilson (MPG) and Dr. J.C. Marshall. Meetings are held approximately once a fortnight, and in this way a more general audience has heard such distinguished scholars as Dr. C. Linde (Berkeley), Prof. J. Ross (MIT), Dr. H. Kolk (KUN), Prof. D. McNeill (Chicago), Dr. W. Deutsch (MPG), Prof. M. Garrett (MIT), Dr. P. Seuren (KUN), Prof. G. Miller (Rockefeller), Dr. Th. Ballmer (Bochum), Dr. W. Brennenstuhl (Bochum), Dr. F. Newcombe (Oxford), Prof. D. Wunderlich (Düsseldorf), Dr. B. Richards (Edinburgh), Dr. P. Harris (Amsterdam), Dr. K. Stenning (Liverpool), and Dr. G. Hitch (M.R.C., Cambridge).

Despite all this "organizing" the Werkgroep has actually found time to do some research, the main strands of which will now be described.

3. WHAT DOES THE WERKGROEP DO?

We shall outline some of the projects that the Werkgroep has undertaken under seven main headings. We can give here no more than the flavour of the research, and would urge anyone who is interested

in specific projects to contract the responsible group members personally.

3.1 Language Acquisition.

3.1.1. Frans van Galen, Chris Hermans, Gerard te Meerman and Matthieu Loffeld have been working on the stimulation of language and cognitive functions in mentally-retarded subjects. Our primary experimental work has concentrated on the acquisition of spatial prepositions. We have run experiments in which normal children between the ages 2;0 and 4;0, and moderately retarded subjects between 6;0 and 20;0 were asked to carry out instructions containing the prepositions IN (=in), OP (=on), and ONDER (=under). In contrast with earlier experiments we used unfamiliar objects, and also controlled for the putative effects of eye-level and motor preference. We also attempted to isolate the effects of non-linguistic response-biases by giving instructions with a "nonsense-preposition". In confirmation of the results of (English-language) work by Eve Clark on normal children, we found that both normal and retarded subjects displayed a response-bias for in-responses when the choice was between in and on or in and under, and for on-responses when the choice was between on and under. A correlational comparison of behaviour in the "real preposition" and the "nonsense preposition" tasks suggested that, for our retarded subjects, an increase in linguistic knowledge may go hand in hand with a decrease in the absolute strength of non-linguistic preferences.

We have accordingly attempted to elucidate further the nature of these non-linguistic strategies that our subjects adopt. We have tested groups of normal children on matched comprehension and production tasks with locative prepositions, and shown some clear superiorities in performance in the production situation. These data are consistent with the claim that, in the standard comprehension task, the child's dominant "non-linguistic strategies" do indeed interfere with his ability to access and use his semantic knowledge. In other experiments we have described these response-biases as attempts to maximize the "locative bond" between two objects. We have manipulated the form of objects used in comprehension tasks (with both normal children and retarded subjects) in order to isolate some of the components of this putative

"locative bond". Our results suggest that the variables of enclosure and support are important determinants of the strength of perceived locative relationships.

A training program to teach spatial prepositions to the mentally-retarded has been devised. The program incorporates design features derived from our experimental studies, and we are currently planning a fairly large scale evaluation of its effectiveness (van Galen and te Meerman, 1978; van Galen, 1978).

Other studies have been carried out on the possibilities of teaching particular syntactic structures to mental retardates. A training program has been constructed, which is made up of series of photographs representing activities that can be described by simple sentence types. Within each series, sentence type is constant. Training consists of teaching the children appropriate descriptions, in the hope that they will internalize the sentence structures and be able to use these same structures in other situations.

A small scale evaluation study has been completed which suggests that the training method can be successful. At the moment, a larger scale evaluation study is planned, together with some experiments that derive from specific training problems noted in the first evaluation study (Hermans, 1978).

Finally, some exploratory work is being undertaken on story comprehension and story-retelling abilities in mental retardates.

3.1.2. In early 1978, Lorraine Komisarjevsky Tyler joined the Werkgroep after her year with the Max-Planck projectgroup. She has continued to study sentence perception and comprehension in children from the standpoint of dynamic developmental relationships between processing procedures and memory. (The framework derives from the information-processing models of sentence comprehension that have been developed with Dr. W. Marslen-Wilson of the Max-Planck project group.) In previous work, Tyler has suggested that because five-year olds have a smaller working memory capacity than older children and adults, they quickly forget the exact lexical and syntactic details of the sentences they hear, and are thus under great pressure to recode semantically the speech input as rapidly as possible. If this conjecture is correct, then the recall pattern of five year olds' should show more evidence

of syntactic clausal organization when the two clauses of a complex sentence are less easily integrated into a single semantic unit. Such an effect should be much less pronounced in older children (Tyler and Marslen-Wilson, 1978).

Tyler has now tested this prediction in a recall task in which a story was stopped at unpredictable intervals and the child had to repeat verbatim the last sentence heard. This last test sentence always contained two clauses; in half the trials the sentences were of high semantic cohesion, and in half of low semantic cohesion. Ex hypothesi, high cohesion sentences should be easy to integrate into a unitary semantic structure, low cohesion sentences should be difficult to so integrate.

The pattern of results was as predicted. The five year olds' recall of the low cohesion sentences was primarily influenced by the syntactic clausal structure, whereas recall of high cohesion sentences showed only a minimal degree of clausal organization. By contrast, the seven year olds' recall of both high and low cohesion sentences was primarily organized according to syntactic structure. The priority of meaning is thus reflected in the dominance of semantic factors in the younger subjects' immediate recall patterns; by contrast, the older subjects' recall patterns exhibit the influence of lexical and syntactic details (Tyler, 1978).

3.1.3. John Marshall and John Morton (M.R.C. Applied Psychology Unit, Cambridge, and Max-Planck projectgroup) have begun a collaboration on the development of the child's metalinguistic abilities, his awareness (either tacit or overt) of the structural and lexical properties of his native language. In particular, we are studying the emergence of "fault-detecting and describing" mechanisms which allow the child to "know" when he has made a speech-error, and to "know" when and where a failure in the comprehension process has occurred. On the basis of a small corpus of errors and error-corrections collected from one child between the ages of two and six years, we have attempted to outline a hierarchy of monitoring and repair processes which are, we believe, crucially involved in the way that the child controls and regulates her own learning.

In contrast with previous work on metalinguistic abilities, we have tried to embed this work within the general framework of an

information-processing approach to language-acquisition. That is, we are interested in the structure of the mechanisms that allow the child to notice and correct his errors. (Marshall & Morton, 1978).

3.2. Acquisition of Spelling and Reading Skills.

3.2.1. Raymond van Rijnsoever has been working with a group in the Institute of General Linguistics, ATW, (under the direction of Professor Kraak) on the acquisition of spelling skills in young Dutch children. Our work is quite closely related to research that professor Charles Read has reported on precocious, spontaneous American spellers, precocious because the children begin to spell (in writing, not orally) at an early age before entering school, spontaneous because they develop their own system with little or no overt teaching.

Our studies constitute a phonemic-graphemic interpretation of spontaneous spelling in Dutch children aged three to five, and an investigation of the spelling patterns and errors of first grade school children. A corpus of spontaneous spellings has been analysed, and on the basis of this analysis a pertinant corpus of words (52 in all) was selected and given for dictation to 125 first graders. Some typical results from this study include i) Grouping the neutral vowel schwa with the rounded mid half-open vowel /u/ in such spellings as "binnen" → BINNU; ii) Spelling schwa as O when it occurs before -r or -l, as in the example "meester" → MEESTOR; iii) context-dependent (apparently) deletion of nasals, as in the spelling "hond" → HOT. Many of these patterns are held in common by precocious readers and first graders but we also noticed some differences. For example, the spontaneous spellers frequently write i for e before either -r or -l (e.g. "weer" → WIR, "speel" → SPIL). Errors of this kind are very rare in first graders, and no doubt reflects the way in which teaching of standard spellings has induced them to rely less on their "untutored" phonetic judgments; iv) Both spontaneous spellers and first graders have a tendency to miss out vowels (especially schwa) before sonorant consonants, e.g. "orgel" → ORGL; v) Consonant cluster reduction is also frequently observed, e.g. "ster" → SER, and "kast" → KAT; vi) Some spontaneous spellers (but no first graders) leave out all vowels in their orthography (e.g. "pinkeltje" → PKT).

In further dictations we have attempted to test specific hypotheses derived from previous analyses. For example, the hypothesis that nasals are deleted only from homoganic clusters ("hand" → HAT) and not from non-homoganic contexts (e.g. "droomt" → DROOMT) seems to be confirmed (Kraak et al, 1977). In yet further experiments we have required first graders to read back their own mis-spellings and the most frequent mis-spellings of other children; we have also given forced-choice tests to see if the children can discriminate between their own erroneous forms and the correct spellings. For some children, discrimination is quite good, but many children show a strong tendency to read back their own errors as the original word ("kent" → KET → "kent").

Professor Read is spending his academic year on sabbatical in ATW, and we look forward to a close collaboration with him in which we will be able to compare in detail the acquisition of the English and Dutch spelling systems. We also anticipate a close working relationship with Dr. P.T. Smith (whose studies of English spelling and stress rules are well known); Dr. Smith will be spending the year at the Max-Planck projectgroup.

3.2.2. René Verdiezen and Gerard Poelwijk have undertaken pilot research on adult illiteracy. They have conducted a number of small-scale quasi-clinical studies of a group of -self-diagnosed- adult illiterates (without known brain damage) who live in the Nijmegen area. The point of these preliminary investigations was to acquire information about exactly what a so-called illiterate can and cannot do when asked to read, and about the variation in skill and knowledge from one "illiterate " to another. In this latter enterprise at least we have been eminently successful.

We have seen subjects who cannot discriminate at an above-chance level between Dutch written (at the word level) left-to-right top-to-bottom, right-to-left bottom-to-top, bottom-to-top left-to-right etc. (By discriminate here we mean pick the correct layout from a set of alternatives). Other subjects score perfectly.

We have constructed a Dutch version of the "mow-motorcycle" test in which the subject is read an (acoustically) long and a short word and is required to pair these stimuli with a visually short and long word. Some subjects score at chance; others are error-free.

We have photographed distinctive environmental signs (e.g. Heineken, Uit, De Gelderlander), and compared the ability of our subjects to read the word(s) on the photograph with their ability to read the same words when typed on plain white cards. In general, "sign" reading is better, but we have seen subjects who only manage to read 16% of the (very common) signs they were presented with. Other could "read" all the signs (but were still seriously impaired with the typed words). This work has been written up as a doctoral paper, and we have a grant to continue these investigations.

3.3. Handwriting: Perception and Production.

3.3.1. It is a strange fact that of the many thousands of experiments on reading that have been reported over the last century only a minute fraction (they can be counted on the fingers of two hands) have investigated how people read handwriting. (The ubiquity of the typewriter is, no doubt, also responsible for the strange theory that the perception of acoustic language is a totally different kind of process from the perception of visual language).

Drs. Henk van Jaarsveld has recently been attempting to redress the imbalance somewhat. Our initial experiments have derived from an early report by Corcoran and Rouse who compared the tachistoscopic recognition of printed (i.e. typed) and handwritten words in the following paradigm. Printed words and words in two handwritings were given for recognition with blocked presentation (i.e. all printed, all in handwriting one, all in handwriting two). Performance in this condition was then compared with two types of mixed condition, randomized print and handwriting, and randomized handwritings one and two. The result was that mixing impaired performance when printed and handwritten words were presented in random order, but there was no decrement for mixing words from two handwritings (compared with their blocked recognition). We thought this latter result unbelievable, and indeed Corcoran and Rouse suspected that the result may have been due to the considerable similarity between the handwritings that they used. We therefore devised an experiment for which we were sure that mixed handwritings would be less efficiently processed than blocked samples. We took two handwritings that were very, very different from each other; lists of

words were presented to 24 subjects in blocked and mixed conditions, where the task was to cancel all the es in the words. Time and error scores were taken.

Exactly as Corcoran and Rouse found, mixing had no effect! Results (both time and errors) in the mixed condition could be predicted perfectly from the means of the two blocked conditions.

We have performed a similar experiment using tachistoscopic recognition probability as the response measure, and found again no deleterious effect of mixed presentation. Our only "success" was when we used naming latency as the response measure. In this condition mixed presentation does indeed seem to result in a reliable lengthening of response times. We are still thinking about this. Perhaps some "on-line" tasks are more "on-line" than others!

3.3.2. Hans-Leo Teulings has been concerned with a rather different aspect of handwriting. With Dr. Thomassen, Dr. Gabreels, and a student-assistant, Annemarie de Jong, Teulings has been investigating timing and control processes for simple, repetitive, writing-like movements in adults and children of different ages.

Our basic apparatus for this project is a so-called "writing tablet", a Vector General XY tablet, connected to a laboratory digital computer. The tablet is written on with a ballpoint pen which contains a pressure-switch. Thanks to Teulings' hard work in programming this device we can register, digitalize, store, and retrieve information concerning the position of the pen tip over time. We can furthermore "clean-up", analyze, manipulate, transform, and display this data in an amazing variety of ways.

Using the device we have run a number of experiments in which subjects are required to produce continuously and repetitively certain simple figures in a variety of sizes. The figures we have used include circles, loops of constant and alternating size, and (relatively) complex figures such as a continuous f (). The simple figures have been written in both a clockwise and counter-clockwise direction. A conjecture to be found in the early literature is that cycle time for such simple figures is a constant irrespective of size. Our own results suggest that (strictly speaking) this conjecture is not true. When adults are required to write our figures as fast as they could over a

range of sizes from 2.5 to 160 mm, we found that cycle time did indeed increase (linearly) from, approximately, 250 ms. per cycle to 500 ms per cycle. One might note, however, that a 64-fold increase in size has only led to a doubling in the time domain. We have repeated this experiment with instructions that the subjects should go at their own most comfortable speed. This leads to a (non-linear) increase in cycle time from, approximately, 360 ms at 2.5 mm to 1050 ms at 160 mm.

In further experiments using a sub-set of the stimulus figures and sizes with children between the ages of 6 and 11, we have found comparable results. When required to write as fast as possible, cycle time does, of course, decrease with age, but over all the age ranges tested we see a linear relationship between size and cycle time. There is also some suggestion in our data that the slope of the regression might decrease with age. We are currently analysing these data further in order to elucidate the interactions of such variables as age, sex, size, direction, and instructions.

We must also mention that, through the courtesy of Dr. Gabreels, Teulings and de Jong have seen a number of children with many different neurological disorders of the motor system. Some of their observations on repetitive, writing-like movements in children with, for example, pathology of the pyramidal or of the extra-pyramidal system can be found in de Jong's Skriptie dissertation (1978). In October, 1978, Teulings will be paying a working visit to the M.R.C. Applied Psychology Unit in Cambridge where he will collaborate on timing studies with Dr. Alan Wing. Teulings is also working with van Jaarsveld on stimulus generalization in the recognition of handwritings.

3.4. Experimental Phonetics.

3.4.1. Pieter Wichern has been involved with many members of Professor Vieregge's Institute for Phonetics in the design and construction of apparatus that will enable us to study the effectiveness of different types of feedback (especially visual) in the learning of new intonation contours. Our aim is to elucidate some of the feedback variables that are useful for the second-language learner (and, hopefully, in the long term for deaf subjects).

Much effort has gone into the construction of an efficient

pitchmeter and ancilliary apparatus that will enable us to detect, digitally process, manipulate and display the fundamental frequency of speech signals. A visual feedback system has been built, consisting of a pitch detector, computer interfacing, and computer filtering and transformation. A computer-controlled display has also been developed. On the basis of pilot studies of the relationship between auditory percepts and our visual displays, we have tried to separate out (by filtering routines) patterns of "micro-intonation" from the perceptually more relevant and crucial aspects of the fundamental frequency contour. This has required the development of a number of non-linear digital filtering techniques.

We have run a fairly large experiment to get some idea of the difficulties of evaluating intonation-imitation and learning with natural auditory and with auditory plus visual feedback. In this experiment we used Swedish sentences (spoken by a native speaker) in order to minimize (for our Dutch and German subjects) the influence of lexical and syntactic components of the perceived intonation contour. Judges, who included the original speaker and the subjects who imitated the stimuli, rated the perceptual similarity of stimulus and imitation, both for their own performance and for that of the other subjects, in the two experimental conditions (with and without visual feedback). We then computed various measures of within -and between- judge reliability, and Gerard te Meerman summarized the data in an elegant factor-analysis. Somewhat to our dismay, the effect of the visual feedback was rather small, and our reliabilities (with the notable exception of the judgements made by Professor Vieregge!) also left much to be desired. We are currently trying to track down the sources of variance and tighten up our experimental procedures. Pieter Wichern will be leaving the project in September, and he will be replaced by Kees de Bot. We then intend to make a major effort on the behavioural, rather than instrumental, aspects of this research.

3.4.2. In the Audiology Center, Drs. Th. Crul has been busy investigating training procedures for hard-of-hearing and speech-disordered children who appear to have particular problems with the categorial perception of speech. A number of these children that Th. Crul has seen fail to show either the sharply-peaked discrimination or the

typical steep crossover function for identification that are found for the perception of stop consonants by normal subjects. In yet others of Crul's impaired children, the crossover function is (fairly) steep, but in the wrong place on the Voice Onset Time (VOT) continuum.

Crul has employed operant procedures to see if these children can be trained (by "shaping" and immediate knowledge of results) to discriminate sharply and in the correct range between contrastive consonant-vowel-consonant pairs (e.g. /dak/vs/tak/). With some of the subjects considerable success has been obtained. In addition to refining the conditioning procedures themselves, the next questions to be posed clearly concern the extent of transfer effects. Will a child trained with one voice generalize a contrast to stimuli presented in another voice? Will a child who has reached criterion on, e.g. a /t/-/d/ pair show generalization to a /p/-/b/ contrast? How long do the effects of training persist? Crul is currently investigating some of these crucial problems.

3.5. Mental Lexicography.

3.5.1. An area of long-standing concern in experimental psycholinguistics is the study of the principles of perceptual coding, lexical access, storage, and retrieval for the (circa) 75,000 (base) words that an adult native speaker has in his vocabulary. A number of simple techniques (tachistoscopic recognition, vocal naming, lexical decision) are available which appear appropriate to the investigation of their issues. It is perhaps unfortunate, however, that the vast majority of studies have employed visually-presented English stimuli; the possibility thus arises that some of the obtained results are restricted to orthographies as peculiar as English.

Annette de Groot accordingly set out to study vocal reaction-times for naming visually-presented Dutch stimuli, which included both native Dutch words and loan words (from French and English). The main results were that loan words took longer to name than native words, and that two-syllable loan words (but not two-syllable native words) took longer than one-syllable words. (Some care must be taken with the interpretation of these results due to problems with frequency matching).

More importantly, the experiment was run in two conditions, one

blocked, where the words in a session were all native or all loan, and the other mixed (where native, French, and English loans were presented in random order). No main effect of or interactions with condition were found; mixed presentation did not lead to an increase in reaction-times. This result is something of an embarrassment for theories that postulate obligatory (pre-lexical) grapheme-phoneme recoding in vocal naming tasks. De Groot followed up this experiment with a further study on the same subjects (n=24) in which the task was changed to lexical decision with manual responding. New stimuli were constructed: Native Dutch words, loan words (French and English), "nonsense" words conforming to Dutch orthographic patterns, and "nonsense" words conforming the either English or French patterns. The results were generally consistent with the English-language literature, i.e. positive responses were faster than negative responses. There was no main effect of native versus loan stimuli, although there was a first-order interaction such that yes responses to native stimuli were faster than to loan, whereas no responses to native stimuli were slower than to loan stimuli. This result is, of course, intuitively reasonable. For the no stimuli, half the items were homophonic with real words, but there was no significant effect of this variable either for the native or loan material. Obligatory phonological recoding seems to be playing no role in these results (de Groot, 1977).

Because we used the same subjects in the two experiments it was possible to correlate their reaction-times across the two tasks. The correlation was low and insignificant ($r = +0.23$). This might suggest that the two tasks are tapping functionally distinct mechanisms. We accordingly embarked on an experimental series to study this issue in more detail.

3.5.2. The general problem raised by de Groot's last mentioned finding is this: When we investigate word recognition and retrieval by using two (or more) experimental techniques, to what extent is the subject variance held in common between the different paradigms or conditions, and to what extent is the stimulus variance held in common between paradigms? A group consisting of Kees de Bot, Annette de Groot, Patrick Hudson (PF), and John Marshall has been at work on these problems.

De Bot first ran a standard lexical decision experiment (with

manual responding) with Dutch words and two types of non-words (orthographically legal and illegal). The subject correlations (reaction times) between the three stimulus conditions were impressively high; they ranged between + 0.95 and + 0.98! Half of the subjects (n=11) were called back to repeat the experiment. Test-retest reliability (over subjects) was high (+ 0.86). Subjects, then, seem to have a reliable "individual constant" for performance in this task.

Next, de Groot ran 24 subjects in both a manual lexical decision experiment (with only legal non-words as negative stimuli) and a vocal naming experiment. Exactly the same stimuli were used in both experiments. Within task subject correlations were again high (+ 0.91 and + 0.94), but the between-task (Lexical Decision versus Vocal Naming) subject correlation was zero (or more precisely + 0.03!) The "individual constant", then, would appear to be task (or response modality) specific. Furthermore, the stimulus correlations between tasks were also low; they range (across the different counter-balanced conditions and stimulus subsets) from -0.19 to +0.44. Whatever the factors that make some stimuli easy and others difficult to cope with in lexical decision are not, on the whole, the same factors that produce differential difficulty in vocal naming.

De Groot and de Bot then called back all the subjects and re-tested them with the same stimuli in a lexical decision experiment with vocal (not manual) responding . The subjects now said "Ja" or "Nee" rather than pressing appropriate keys. The first upshot of this was the discovery that, in terms of subject variance, vocal lexical decision correlates to a (slightly) greater extent with vocal naming than it does with manual lexical decision. A fair proportion of the subject variance, then, is tied to the mode (vocal or manual) of responding. When we turn, however, to the stimulus variance we now find a reasonable correlation (for positive responses) between the results of manual and vocal lexical decision (r = +0.69). There is, in other words, reliable word variance tied to the lexical decision task.

De Bot has recently completed a pilot experiment (n=24) in which the same subjects and stimuli are used in three tasks, manual lexical decision, vocal naming, and tachistoscopic recognition. Practically no subject variance is held in common across the three tasks, and very little stimulus variance is common.

A fair summary of our results would be this: Anyone who thinks that the standard word recognition and retrieval tasks are tapping the same internal lexicon in approximately the same fashion is wrong.

Drs. de Groot has recently spent some time with the M.R.C. Applied Psychology Unit in Cambridge, working with Dr. John Morton and other Unit members. We extend our sincere thanks to the director, Dr. Alan Baddeley, for allowing us to build up our links with his Unit. We hope to be able to continue and expand this line of research, and, to this end, a new grant application (from Hudson, Marshall, and Thomassen) has been lodged with ZWO to pursue "priming" studies of the internal lexicon.

3.6. Cerebral Organization and Language Disorders.

3.6.1. Many members of the Werkgroep have long-standing interests in the development of cerebral specialization for language. Of particular concern is the issue of whether the left-hemisphere does indeed "develop" dominance for language-skill (as a consequence of maturation, experience etc.) or whether it is "innately" pre-eminent (in this respect) from birth (or a very early age).

Paul Eling (with Gerard van Galen and other members of the Unit) is studying this issue within the traditional dichotic listening paradigm, using a variety of response-measures of which the most important will be reaction-time. Although previous studies seem to suggest that the right ear advantage (REA) does not increase with age (over the age range that relatively direct report measures can be elicited), our aim is to "factorize" some of the components (e.g. phonologic and semantic) of the ear advantage for speech in order to see if there is "development" of lateral specialization for any individual components.

During the early months of the project considerable time was devoted to soft-ware development; a number of programs and subroutines were written to facilitate the preparation of different types of dichotic tapes.We have also constructed a very general program to record and manipulate the speech signal from the tape recorder. We can now create quite quickly datasets of stimuli; we can transform these sets by deletion, insertion, and re-ordering.

We then had to consider what type of alignment should be used in

our dichotic tapes. We were particularly concerned with the claim of Marcus (IPO) and Morton (Cambridge) that onset alignment of stimuli should be superceded by P-centre (= Perceptual centre) alignment. Accordingly we determined the P-centres of the Dutch digits "one" to "ten" by Marcus' method. In agreement with his results for the English digits we found high between-subject agreement in P-centre alignment. The formula that Marcus proposed to calculate P-centres from acoustic waveforms predicted very well (r = +0.95) our empirically-determined P-centre values.

24 adult subjects were then run with onset-aligned tapes and P-centre aligned tapes in a within-subject design laterality experiment. A standard free-recall paradigm was used with three pairs of digits per trial. The P-centre tape is considerably easier than the onset-aligned tape, and there is some suggestion that, as Marcus predicts, a smaller standard deviation is found in the data from the P-centre condition. The magnitude of the ear advantage, however, seems but slightly affected by alignment type. In a further experiment using probe reaction-time as the response measure no significant differences were found between onset aligned and P-centre aligned tapes.

In preparation for our main experiment we have also run a number of dichotic studies with both normal and learning-disabled children, age 8 to 9 years. The task we have used is to give a so-called "probe" stimulus (non-dichotically) following which the subject must report whether or not either member of a dichotically-presented pair matches the probe. The main experiment to compare the ear advantage at different ages on phonological and semantic probe tasks (identity and category monitoring) is now ready to run.

3.6.2. Patrick Hudson (PF) and John Marshall have continued to work on the biological theory of cerebral asymmetries. We have taken a close look at Corballis and Morgan's claim that human asymmetries can usefully be interpreted within the general context of structural asymmetries in other species (from snails upwards). In support of the postulate "Heritable yes, Genetic no", Corballis and Morgan have argued that departures from symmetry are the result of spatially-coded oocytic asymmetries, the overt expression of which is often genetically buffered. In Hudson and Marshall (1978) we have remarked upon some of the

difficulties that this account runs into when dealing with the apparent breakdown of such buffering which finds expression in human handedness and left hemisphere dominance for language. Continuing to pursue this latter point we have also made an attempt to explicate some of the models which might underlie neuropsychology's central dogma, namely that cerebral lateralization for language and speech functions is "a graded characteristic, varying in scope and completeness from individual to individual" (Zangwill). This, in turn, has involved us in further studies of variability within the population of left-handers for motor-, language-, and cognitive-functions. We have reviewed, and found wanting, the claim that substantial subgroups of left-handers suffer from "pathological influences" upon cerebral functioning.

3.6.3. We shall be expanding our work on traumatic pathologies of language in adults with Dr. Herman Kolk's (PF) grant (from ZWO) to study disorders of sentence structure in aphasia. One of the most striking aspects of the spontaneous language production of subjects with so-called "Broca's aphasia" is the "telegrammatic" style of their speech (and often their reading and writing). Function words and bound morphemes (both inflectional and derivational) show a drastic reduction in their frequency of occurrence compared with normal speech. A central theoretical issue is this: should the disorder be characterized at a relatively peripheral level as a failure to "read" functors into and express them in phonological or articulatory programs, or is it rather the case that the syntactic categories themselves are (relatively) unavailable to the process of elaborating the structural descriptions that control language production? (Marshall, 1977).

While in Boston (at the Veterans Administration Hospital) Kolk performed a number of studies showing that Broca's aphasics give different responses from normal subjects when asked to indicate (non-verbally) their "intuitions" of relatedness or cohesion between the words of a sentence. They tended to group the function words together into one cluster and the content words together into another cluster, rather than their responses showing the usual pattern of dependence upon constituent-structure properties. This result tends to confirm the claim that the function-word deficit is not solely an output constraint at a fairly peripheral level. Secondly, Kolk conducted extensive training experiments with Broca's aphasics which demonstrate that they are

responsive to both surface-structure and deep-structure configurations. When cued in an appropriate fashion, they proved able to produce a surprisingly large and varied range of syntactic types.

Finally, Bradley (MIT), Garrett (MIT), Zurif (VA, Boston) and Kolk demonstrated that Broca's aphasics - like the subjects with deep dyslexia discussed in the following section - can perform lexical decision tasks with a fair degree of accuracy. They do well even with those function words that are lacking in their spontaneous speech. However, unlike normal subjects, they show a frequency effect with function words in this task. This suggests that function words might become part of the general lexical store in Broca's aphasia (content words show a frequency effect for both normal and aphasic subjects) rather than being accessed from a "special purpose" store.

We intend to repeat and extend studies of this nature with a population of Dutch-speaking aphasics.

3.6.4. Dr. Freda Newcombe (The Churchill Hospital, Oxford) and John Marshall have continued their work on acquired dyslexia in adults. We have elaborated our taxonomy of error-types, consequent upon brain-damage, in reading, and have begun to relate our taxonomy to the patterns of more general aphasic impairments that are characteristically associated with some (but not all) of the varieties of traumatic dyslexia (Marshall and Newcombe, 1977). Studies of recovery from dyslexia have also been carried out. We have conducted longitudinal studies in which patients are repeatedly tested on reading-tasks and also on an object naming task. We then fit recovery curves to the obtained data and attempt to justify the parameters which figure in the mathematics. The interest of such recovery curves lies in the fact that rate of change clearly differs from patient to patient, and in the somewhat surprising finding that for some patients the task which is most impaired in the weeks immediately after injury recovers to a better level of asymptotic performance than the task that was originally less impaired. The long-term goal of such work is to refine the predictive power of the curves (by extrapolation) to the point where changes in acceleration consequent upon therapeutic procedures can be used as an assay of the efficacy of such intervention.

We have also devoted some time to working out the contents of a

precise clinical examination of purported cases of dyslexia and dysgraphia, an examination that will allow the patient's particular pattern of loss and retention to be adequately described (Newcombe and Marshall, 1978).

Finally, we should mention the continuing effort that we (and many other workers) have devoted to unravelling the mysteries of "deep dyslexia": This is a putative symptom-complex which has as its most striking feature the fact that previously literate adults when attempting to read aloud individual words (without context, time pressure, or stimulus-degradation) produce surprising numbers of frank semantic errors. They will read, for instance, uncle as "cousin", or afternoon as "tonight". The relationship of this syndrome to recent studies of normal reading processes is described in Ellis and Marshall (1978).

The culmination of this effort was the Cambridge Meeting (September 1978) on deep dyslexia, organized by Professor Max Coltheart (University of London), Dr. Karalyn Patterson (M.R.C., Cambridge) and John Marshall, and sponsored by the British Medical Research Council. This symposium was attended by scholars active in the area from Europe, Britain, North America and Japan.

3.6.5. In contrast to these experimental investigations, David Fryer (University of Edinburgh) and John Marshall have been studying the development of neuropsychological theory from the Greeks to the present. Our aim has been to outline this history from the viewpoint of the elaboration of formal (i.e. "mechanical") models of behaviour and brain-function. In part, the work can be regarded as a history of artificial intelligence and the simulation of behaviour. The hypothesis that psychological theories tend to arise by "displacement of concepts" from the physical domain to the mental domain has frequently been advanced, but rarely documented or examined closely. Mechanical metaphors drawn from the high technology of the day have always been the primary source for this particular mode of coming to grips with the invisible, insubstantial "mind". The strategy of displacement was first formulated clearly in the aftermath of the Ionian enlightenment, and it has continued to be applied throughout successive technological revolutions to the present day. The crucial role played by physicians, and in particular by neurologists, in propagating technological metaphors of

human behaviour and brain-function is stressed (Marshall, 1977). These "machines of the mind" have provided a very general framework which allowed mental processes to be studied as if they were physical processes but which does not lead to reductionism. The twin dilemmas of "behaviourism" and "spiritualism" are thus neatly avoided (Fryer and Marshall, 1978).

A detailed account of the history of models of memory is given in Marshall and Fryer (1978). Fryer and Marshall (1978) is a case-study of the greatest of all 18th century automata-makers, Jacques de Vaucanson. We describe a representative sample of his inventions, the duck, the tabor-pipe player, and the German-flute player, and we link his -overtly stated- philosophical intentions with those of modern computer theorists.

3.7. The Special Project on the Comprehension and Production of Descriptive Language.

Our aim in this project (referred to in the introduction) is to understand some of the processes of comprehension and production as on-going computations that involve all levels of structure from pragmatic concepts of the speaker-hearer relationship to the details of the acoustic wave which finally realizes our communicative intentions (Levelt, Marshall and Bouma, 1977). In order to make the project manageable we shall conduct the bulk of our experimental work within a common situational framework -the description of simple objects, actions, events and states-of-affairs. The sub-projects are also unified by adoption of a common methodology: Our techniques will involve miminal delay between the behaviour of the subject and our measurement of the parameters of that behaviour ("on-line" measurement). The four sub-projects are as follows:

a. Dr. S.G. Nooteboom's group will be studying the communicative functions of pitch accents in descriptive discourse. Particular attention will be paid to the acoustic and phonological components of the speech signal which help to mark the distribution of new and old (or given) information within an utterance.

b. Dr. G. Kempen's group will study syntactic aspects of producing picture description. We intend to devise formal (computational) models of some of the stages involved in selecting conceptual content for

expression, and in "translating" conceptual into syntactic structures. Experimental work will proceed hand-in-hand with computer simulation.
c. Dr. P. Seuren's group will study linguistic aspects of anaphora and cohesion in descriptive language. Formal descriptions of anaphoric reference will be supplemented by psychological work on the processes whereby anaphoric reference takes place successfully (or otherwise!) in communicative situations. (Pieter Seuren will also direct another interdisciplinary project for the Werkgroep, a logical, linguistic and psychological study of causality as a category in conditional sentences).
d. Dr. W. Deutsch's group is working on the "speaker-hearer contracts" that children make when producing and comprehending object descriptions. Here we are concerned with how children identify objects and actions from the descriptions of others: we shall also study how children learn to be effective describers who take the situation and audience into consideration.

4. AFTERWORD

It will be seen from the foregoing that we have covered a lot of ground in the last two years. The next priority is now to start digging a little more deeply. We are beginning to see certain main themes emerging from the Unit's work, and must now think seriously about the directions in which we intend to move.[1]

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